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INTRODUCTION

For over two decades the United States and the Soviet Union have used satellites for military purposes. As a result of recent technological advances, military satellites will soon be able to play a more significant role in terrestrial conflicts. These space assets will be able to supply more types of information, more rapidly, to more diverse locations. Some will carry out target acquisition, tracking, and kill assessment functions, thus operating more directly than before as components of weapons systems.

This growing military utility also makes satellites attractive targets for opposing military forces. Both the Soviet Union and the United States have been developing anti-satellite (ASAT) weapons. These weapons could weaken the opponent's military capabilities by depriving his forces of the services of some satellites. The existing Soviet anti-satellite weapons—and future, potentially more effective ASATS –pose a growing defense problem for the United States.

A variety of unilateral measures, passive and active, may improve the survivability of U.S. military satellites. At present, it is unclear whether such survivability measures will be adequate to guard against the highly developed ASAT threats of the future. Another possible contributor to satellite survivability is mutually agreed arms control. A judicious combination of certain arms control measures and unilateral satellite survivability measures might provide more security to U.S. military satellites than either type of measure alone.

At the same time, however, arms control measures which constrained the threat to U.S. satellites would also constrain the ability of the United States to weaken Soviet military capabilities by attacking their satellites in time of war. In addition, limits on ASATS would severely limit the kinds of ballistic missile defense weapons that might be deployed in the future. (The subject of ballistic missile defense is dealt within a companion OTA report, Balistic Missile Defense Technologies.)

This report explains the dilemmas facing U.S. policymakers and assesses the pros and cons of some options for dealing with the challenge of anti-satellite weapons, particularly in the light of projected future weapons technology.

PRINCIPAL FINDINGS

Current Soviet military satellites pose only a limited threat to U.S. military capabilities, but future space systems will pose a greater threat.

The Soviet Union currently uses satellites to perform a wide variety of tasks including missile launch detection, communications, navigation, meteorological surveillance, photographic and radar reconnaissance, and collection of electromagnetic intelligence (e.g., radar emissions). Many of these satellites, although not "weapons" themselves, support and enhance the effectiveness of terrestrial Soviet forces that would engage in direct combat. For example, if navigation satellites improve munition delivery accuracies, then fewer munitions are required to accomplish a given objective. The growing military utility of satellites has rekindled U.S. interest in ASAT weapons.

Some Soviet satellites already supply limited targeting information to other terrestrial

assets. The Administration has expressed its concern about:

> . . . present and projected Soviet space systems which, while not weapons themselves, are designed to support directly the U. S. S.R. 'S terrestrial forces in the event of a conflict. These include ocean reconnaissance satellites which use radar and electronic intelligence in efforts to provide targeting data to Soviet weapon platforms which can quickly attack U.S. and allied surface fleets. [1]

At present Soviet radar (RORSAT) and electronic intelligence (EORSAT) ocean reconnaissance satellites pose only a limited threat to U.S. and allied surface fleets. RORSATS and EORSATS are typically deployed at altitudes and inclinations which offer limited observation range. Although the observation "swath" of these satellites will eventually cover most of the Earth, if only one or two of these satellites are operational-as has been customary in peacetime-then a ship would be exposed to observation only intermittently and might successfully evade the satellite. The Soviet Union could increase the number of deployed RORSATS and EORSATS, thereby making evasion more difficult. Other countermeasures exist which could further reduce the threat posed by these satellites, but such measures might not be available to merchant resupply vessels operating during a protracted non-nuclear conflict.

In the future, sophisticated communication, navigation, and surveillance satellites are likely to play a greater role in all levels of terrestrial conflict. This will increase the incentive for both the United States and the Soviet Union to develop and deploy ASAT weapons.

Possible responses to the threat posed by Soviet military satellites are numerous and diverse.

A variety of options are available to mitigate the threat to U.S. and allied security posed by Soviet military satellites (MILSATS).

[1] President Ronald Reagan, Report to the Congress: U.S. *Policy on ASAT* Arms Control, Mar. 31, 1984.

These options include nondestructive as well as destructive measures; those presented below are not mutually exclusive.

- Possible nondestructive responses to Soviet MILSATs:
  - Force Augmentation: U.S. combat or support forces could be increased to counter the increase in effectiveness which Soviet forces could derive from use of military satellites. Force augmentation is often, but not always, more costly than other means of mitigating the threat posed by Soviet military satellites.
  - Passive Countermeasures: By using passive measures to conceal or disguise their identity and nature, U.S. forces could reduce the utility of Soviet reconnaissance satellites. For example, assets now detectable by radar might be redesigned to reflect radar signals only weakly in order to evade detection by radar satellites, or radio silence might be practiced, or covert signaling techniques used to prevent detection by satellites that collect signals intelligence.
  - Electronic Countermeasures and Electro-optical Countermeasures: Electronic countermeasures such as "jamming" (i.e., overloading enemy receivers with strong signals) and "spoofing" (i.e., sending deceptive signals) could be used to interfere with satellite functions. Electro-optical countermeasures such as "dazzling" (temporary "blinding") or spoofing optical sensors are also available. However, these countermeasures —especially spoofing—require detailed knowledge of the satellite systems (e.g., operational frequencies, receiver sensitivity, etc.) against which they are directed.
- Possible Destructive Responses to Soviet MILSATs:
  - Inadvertent But Inherent ASAT Capabilities: The inherent ASAT capabilities of nuclear weapons such as ICBMS and SLBMS could be used to destroy low-altitude Soviet satellites; with some modifications, these weapons might

also be used to attack satellites at higher altitudes. Some types of nonnuclear interceptors (e.g., that demonstrated in the U.S. Army's 1984 Homing Overlay Experiment (HOE)) which might eventually be developed and deployed for BMD purposes, would have some inherent ASAT capability. Finally, any highly maneuverable spacecraft capable of noncooperative rendezvous—e.g., the U.S. Space Shuttle—has some ASAT potential.

—Planned ASAT Weapons: When operational, the current USAF MV ASAT weapon will be able to destroy Soviet military satellites in low-Earth orbit.

–Advanced ASAT Weapons: Space- or ground-based directed-energy weapons or advanced kinetic-energy weapons could be developed that would be able to destroy Soviet satellites beyond the range of existing or planned U.S. ASAT weapons.

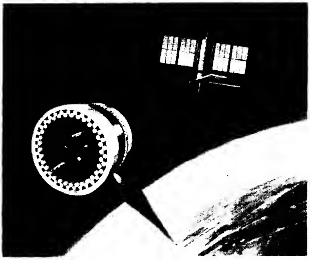
The United States is now more dependent on satellites to perform important military functions than is the Soviet Union.

In choosing between ASAT weapon development and arms control, one wishes to pursue that course which makes the greater contribution to U.S. national security. This is often characterized as a choice between developing a capability to destroy Soviet satellites while assuming U.S. satellites will also be at risk, or protecting U.S. satellites to some extent through arms control while forfeiting effective ASAT weapons. The better choice could, in principle, be identified by comparing the utility which the United States expects to derive from its military satellites with the disutility which the United States would expect to suffer from Soviet MI LSATS during a conflict. Such a comparison-although possible in principle–is made exceedingly difficult by the number of conflict scenarios which must be considered and by the lack of consensus or official declaration about the relative likelihood and undesirability of each scenario.

Although national utility for space system support is difficult to assess precisely and meaningless to compare between nations, it is apparent that the United States is more dependent on MILSATS to perform important military functions than is the Soviet Union. The United States has global security commitments and force deployments, while the Soviet Union has few forces committed or deployed outside the borders and littoral waters of members of the Warsaw Treaty Organization and Cuba. The United States has corresponding requirements for global and oceanic command and control communications (C^3) capabilities and relies largely on space systems to provide these requirements. The Soviet Union, on the other hand, can rely on landline communications systems and over-the horizon radio links for many of its C' needs. Satellite communications links are used by the Soviet Union but are not as essential as those of the United States. In addition, the Soviet Union has greater capability to reconstitute satellites which are lost in action; hence even to the extent the Soviet Union is dependent on space system support, it is less dependent on individual satellites for some functions. The United States also has fewer alternative terrestrial means for collecting intelligence than does the Soviet Union, which can exploit the freedom and openness of U.S. society for this purpose.

Soviet ASAT capabilities threaten U.S. military capabilities to some extent now and potentially to a much greater extent in the future.

The Soviet Union tested a coorbital satellite interceptor system from 1968 until its self-imposed moratorium of August 1983. The Reagan Administration considers this ASAT system to be operational. The interceptors are believed to be capable of attacking satellites at altitudes of up to 5,000 kilometers, depending on their orbital inclination. At present there appear to be only two launchpads for Soviet coorbital interceptors, both located at Tyuratam.



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attractive targets. Both the United States and the Soviet Union have been developing anti-satellite (ASAT) weapons

The existing Soviet ASAT weapon may be effective for negating low-altitude U.S. military satellites, such as are used for navigation (Transit), meteorological surveillance (Defense Meteorological Support Program satellites), and other purposes. Assistant Secretary of De fense Richard Perle has stated:

> We believe that this Soviet anti-satellite capability is effective against critical U.S. satellites in relatively low orbit, that in wartime we would have to face the possibility, indeed the likelihood, that critical assets of the United States would be destroyed by Soviet anti-satellite systems. . . . If, in wartime, the Soviet Union were to attack critical satellites on which our knowledge of the unfolding conventional war depended, . . . we would have little choice but . . . to deter continuing attacks on our eyes and ears, without which we could not hope to prosecute successfully a conventional war. [2]

[2]Statement of The Honorable Richard Perle, Assistant Secretary of Defense (International Security Policy), in Hearings before the Subcommittee on Strategic and Theater Nuclear Forces of the Senate *Committee* on Armed Services: Review of the FY 1985 Defense Authorization *Bill*, Mar. 15, 1984 [S.Hrg. 98-724, Pt. 7., p. 3452].

The current Soviet interceptor and the booster that it has been tested with cannot reach critical U.S. early warning and communication satellites in high orbits. If the Soviet ASAT weapon were mated with a larger booster—a procedure which has yet to be tested—it might be able to reach these U.S. satellites.

In addition to the coorbital interceptor, the Soviet Union is testing ground-based lasers which the Reagan Administration believes have ASAT capabilities. The U.S. Department of Defense estimates that the U.S.S.R. could test a space-based laser within the decade.[3] Advanced directed-energy weapons such as lasers and particle beam weapons–if developed and deployed—could give the Soviets an "all altitude," "instantaneous kill" capability. As the United States increases its reliance on space systems to perform vital military functions (e.g., the MILSTAR communication satellite system), an increase in Soviet ASAT capabilities could create a significant threat to U.S. national security.

[3]U.S. Department of Defense, Soviet Military Power, 1985, p. 44.

Aside from its intentional ASAT capabilities, the Soviet Union could currently attack low-altitude satellites with its nuclear ABMs, ICBMs, and SLBMS. With some modification, these nuclear assets might also be used to attack satellites in higher orbits. Current Soviet spacecraft (i.e., Soyuz, Salyut), because of their limited maneuter and rendezvous capabilities, do not hate a significant ASAT potential. Future Soviet spacecraft, such as the expected Soviet "Shuttle" and space plane, will have greater inherent ASAT capabilities. The Soviets also have the technological capability to conduct electronic warfare against space systems.

Several technologies on the horizon could lead to a new generation of highly capable ASATS.

The following advanced ASATs could be developed and deployed by either the United States or the Soviet Union:

- *Space Mines:* These would be deployed within lethal range and would continuously trail their target. Using a conventional or nuclear explosive charge, a space mine would destroy its quarry almost instantly on command or (if salvage-fused) when attacked or disturbed.
- High-Power Radio-Frequency Weapons: These would be devices capable of producing intense, damaging beams of electromagnetic radiation that could be used to jam communication and radar systems at low power levels or to overload and burn out satellite electronics at higher power levels;
- High-Energy Laser Weapons: High-energy lasers may eventually be capable of producing intense, damaging beams of electromagnetic radiation that could jam optical communication and sensor systems at low power levels or cause permanent damage at higher power levels. Ground-based lasers would have infrequent opportunities to attack satellites but, unless attacked themselves, could shoot inexpensively and repeatedly. Space-based reflectors could also be used to relay laser beams from ground-based lasers to their targets. Spacebased lasers

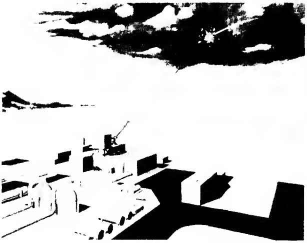

Photo credit U S Air Force

Artist's conception of the High Energy Laser Test Facility currently under construction at White Sands Missile range. New Mexico

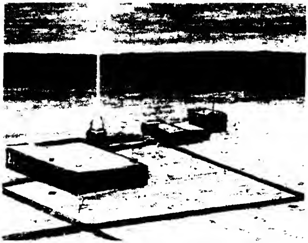

Photo credit U S Department of Defense

Artist's conception of high-energy laser facility at the Sary Shagan test facility in the Soviet Union,

High-energy lasers may eventually be effective ASAT weapons, Ground-based lasers would have Infrequent opportunities to attack satellites, but, unless attacked themselves. could shoot inexpensively and repeatedly,

might be able to attack several satellites in quick succession; space-based X-ray lasers might be able to attack several satellites instantly and simultaneously.

- Neutral Particle Beam Weapons: Powerful particle accelerators, similar to those now used in scientific research, might eventually be developed which could destroy the hardened electronics of a spacecraft.
- Kinetic-Energy Weapons: Space- or ground-based kinetic-energy weapons (similar to the current U.S. MV ASAT) would probably be small, homing vehicles that destroy their target by colliding with it at extremely high velocities.

Possible U.S. responses to the Soviet ASAT threat are numerous and diverse.

The United States could respond to the threat posed by the Soviet ASAT threat in several ways; both unilateral and diplomatic options are available.

- Possible unilateral responses to Soviet ASATS:
  - –Reduce Dependence on Military Satellites: No matter what satellite survivability or arms control measures are taken, there will always be some risk that critical satellites can be destroyed or rendered inoperable. The United States must exercise caution in the extent of its reliance on space assets to perform tasks essential to the national security. Nonetheless, some space systems perform vital military functions which cannot be duplicated—or can be duplicated only imperfectly-by terrestrial systems.
  - –Passive Countermeasures: Passive countermeasures such as hiding, deception (use of decoys), evasion (maneuvering), hardening (making satellites more durable), and proliferation (adding more satellites) all offer significant protection from the current and perhaps future Soviet A SAT weapons. Decoys would probably be effective against a wide variety of ASAT weapons and will be particularly economical for the protection of small satellites capable of being imitated by small, cheap decoys. Combinations of these passive responses—e.g., decoys for "dark" spare satellites–could offer even greater protection than individual measures alone.
  - —Active Countermeasures: Active countermeasures may be destructive or nondestructive. Destructive countermeasures could include giving satellites a self-defense capability or providing critical satellites with an escort defense. Nondestructive countermeasures might include electronic countermeasures and electro-optical countermeasures such as jamming. Attacking Soviet ASAT control facilities is also a potential-though dangerous— active countermeasure.
  - –Deterrence: The Soviets might be deterred from attacking U.S. satellites if the United States declared its willingness to retaliate for attacks on U.S. space assets. Such retaliation could be against Soviet space assets, in which case the United States would need a capable ASAT weapon, or it could be against Soviet terrestrial assets. The former alternative assumes that the Soviets value the preservation of their satellites at least as highly as they value the destruction of U.S. satellites. The latter alternative, of course, carries a greater risk of uncontrolled escalation if deterrence should fail.
  - –Keep-Out Zones: The United States could declare and defend protective zones around critical satellites. Defended keep-out zones could offer significant protection against current ASAT weapons for some satellites. This subject is discussed in detail below.
- Possible diplomatic responses to Soviet ASATS:
  - –Arms Control; The United States, the Soviet Union, and other spacefaring nations could negotiate limitations on the testing, deployment, or hostile use of anti-satellite systems.

–Rules of the Road: The United States, the Soviet Union, and other spacefaring nations could negotiate restrictions on potentially provocative activities in space, such as unexplained close approaches to foreign satellites or irradiation of foreign satellites with low-power directed-energy beams. With such agreed restrictions in force, these activities would justify defensive or retaliatory measures.

Of the future ASAT weapons now foreseeable, those which would be most effective if used in a preemptive or aggressive surprise attack would be space-based and therefore subject to attack by similar weapons.

Preemptive attack would be an attractive countermeasure to space-based ASAT weapons. If each side feared that only a preemptive attack could counter the risk of being defeated by enemy preemption, then a crisis situation could be extremely unstable. While salvagefusing, if it proved practicable, would diminish this risk, it would create a risk of space war breaking out by accident. For example if a meteoroid destroyed a satellite, it might set off a chain reaction of salvage fusing which would destroy all satellites. To the extent that protection was sought through "shoot-back" rather than "shoot-first" tactics, a premium would be placed on having the biggest and best ASATS deployed, which could lead to an intense arms race.

Foreseeable passive or active countermeasures may be inadequate to guarantee the survival of large inilitary satellites attacked by advanced ASAT weapons.

Passive or active countermeasures might have only limited effectiveness against very advanced ASAT or BMD weapons. For example, it might be uneconomical to rely on passive measures to protect large and expensive satellites from a powerful neutral particle beam weapon. Shielding satellites against a neutral particle beam weapon could cost more than it would to scale up the weapon to penetrate the shielding, and such a weapon could slew its beam quickly enough to make evasion infeasible. With such a weapon it might be as economical to damage spare satellites as they are brought "on line' as it would be to damage initially operational satellites.

Active measures, such as "shoot-back" with a weapon of longer effective range, could provide protection against some A SAT weapons but not against weapons such as space mines or single-pulse lasers which could destroy satellites instantly and without warning. However, it might not be economical to attack satellite systems composed of many small, cheap satellites—and possibly decoys as well—with expensive advanced ASAT weapons. Such satellites could perform a number of important functions (e.g., communication or navigation) without encouraging a proliferation of advanced weapons to attack them. Therefore, although it would be difficult to protect individual satellites, satellite systems performing some critical functions might retain a fair degree of survivability.

A commitment to satellite survivability is important whether or not ASAT development, or arms control, or both, are pursued.

The United States should place more emphasis on means to ensure the survivability of critical military satellites and, particularly, their associated ground stations and data links, regardless of whether ASAT limitations are agreed upon. The existence of non-ASAT weapons (e.g., ICBMS, ABMs) and space systems (e.g., maneuverable spacecraft) with some inherent ASAT capability makes it impossible to ban the ability to attack satellites. Therefore, even under the most restrictive ASAT arms control regime, programs for satellite survivability and countermeasures must be pursued. In the absence of arms control limitations on ASATS, ensuring satellite sur-

viability will be a more demanding task since highly capable directed-energy ASAT weapons or space mines could be deployed.

In the absence of restrictions on the development or deployment of ASAT weapons, satellite survivability can be enhanced if the United States is willing to negotiate or declare keep-out zones and is able thereafter to defend such zones against unauthorized penetration by foreign spacecraft.

Although passive or active countermeasures alone may be insufficient to protect satellites, if combined with keep-out zones they could offer a significant degree of protection from certain ASAT weapons. Without keep-out zones space mines could be predeployed next to all critical military space systems. A keep-out zone of sufficient size would reduce the effectiveness of such weapons. However, advanced, directed-energy or kinetic energy ASAT weapons may be able to function effectively even outside very large keep-out zones.

Should ASAT development be pursued, the United States will need to formulate an employment policy.

At present, no clear consensus exists among those Administration military space policy analysts and executives interviewed by OTA on the conditions under which the United States would attack foreign satellites or on the manner in which it would retaliate for an attack on U.S. satellites. If the United States continues with its ASAT development and deployment plans, it will be necessary to formulate an employment policy.

If the United States wishes to enhance the deterrent value of its ASAT weapons, it may choose to publicize certain aspects of its employment policy. It might, for example, promise that the United States would not use its ASAT capabilities in an aggressive or preemptive first strike but might use them in a defensive or retaliatory reaction to an attack against the United States or its allies, even if U.S. satellites were not attacked. That is, the United States might announce a "no first strike but possible first use' policy for the employment of ASAT weapons as it has for the employment of nuclear weapons.

If defensive satellites (DSATS) are deployed by the United States to defend its satellites, or if certain satellites are given self-defense capabilities, the United States would have to de cide under what circumstances it would use these assets and whether it wished to publicly announce this employment policy. The United States might declare in advance that it would fire at satellites suspected of being ASATS if they approached U.S. satellites within possibly lethal range. However, such a declaration would have an uncertain legal status and might generate considerable political opposition from both spacefaring and non-spacefaring nations.

Certain arms control provisions would reduce the probability that advanced ASATS will be developed or deployed. However, arms control could not guarantee the survival of U.S. satellites attacked by residual or covert Soviet ASAT weapons.

Arms control provisions, such as a ban on all testing of all systems "in an ASAT mode," would reduce the likelihood that the Soviet Union could successfully develop and deploy advanced, highly capable ASAT weapons. The categories of weapons eliminated might include space mines capable of "shadowing" valuable military assets in any orbit, directed-energy weapons with kill radii of hundreds to thousands of kilometers, and advanced kinetic-energy weapons. In the absence of an agreement limiting their development, each side would have a strong incentive to seek continually more effective means to attack threatening satellites and to defend valuable assets. In the absence of adequate countermeasures, the "instantaneous kill" capability of some advanced ASATS might be destabilizing in a crisis, because they would give each side an incentive to "shoot first" or else risk the loss of its space assets.

Photo cred(I Lockheed

Launch of U.S. Homing Overlay Experiment (HOE) to test nonnuclear anti-ballistic missile technology,

Photo cred(t U S Deparfment of Defense

Artist's conception of the Soviet GALOSH ABM interceptor currently deployed around Moscow.

ABM interceptors may have some inherent ASAT capabillties, ABMs, as well as ICBMS and SLBMS, present a threat which may not be easily resolved through arms control,

A ban on testing weapons in an A SAT mode would be less effective at reducing the threat posed by weapon systems with inherent ASAT capability and by the existing Soviet ASAT weapon. ICBMS, SLBMS, and ABM interceptors with nuclear payloads are examples of systems with residual ASAT capability. Although these systems lack the kind of precision guidance necessary to actually collide with a satellite, the long-range destructiveness of their nuclear payloads makes them potentially effective ASATS. The Shuttle's recent success at retrieving satellites strongly suggests the ASAT potential of future maneuverable spacecraft, although costly vehicles like the Shuttle would probably not risk approaching satellites which might be booby-trapped. However, the range, effectiveness, and reaction time of even advanced maneuverable spacecraft not designed as weapons would be substantially less than those of intentional ASAT weapons. Although the development of maneuverable spacecraft would not be inhibited by most ASAT testing limitations, some limits could be placed on operating them "in an ASAT mode. "

Arms control provisions might substitute for passive and active countermeasures in reducing the threat posed by ASAT weapons, but arms control would be more effective if combined with countermeasures.

U.S. satellites can be protected either by increasing their survivability or by reducing the threat posed by Soviet ASAT weapons. Passive or active countermeasures are designed to do the former while arms control provisions would hopefully do the latter. In considering the advantages and disadvantages of ASAT arms control, ASAT development, and countermeasures, it is important to consider them in packages. A combination of arms control provisions and passive countermeasures, for example, or of passive countermeasures and active countermeasures, could provide greater security than each component of such a package might provide alone.

The benefits of most ASAT limitations conflict with the benefits of ASAT exploitation.

Although ASAT arms control might prevent the Soviet Union from developing advanced, highly capable ASAT weapons, it would also place a similar restriction on the United States. Therefore, although U.S. satellites might be less vulnerable to ASAT attack, the United States would have to give up the ability to strike at Soviet satellites which threaten U.S. and allied forces. Although arms control might prevent an expensive and potentially destabilizing arms race in space, it would also limit the ability of the United States to use its comparative advantage in advanced technology to protect U.S. satellites and place threatening Soviet satellites at risk.

Not all arms control regimes are inconsistent with ASAT development or deployment. "Rules of the road" for space–e.g., negotiated keep-out zones—might be pursued simultaneously with ASAT research, testing, and deployment.

Effective ASAT arms control would likely place significant restrictions on the testing and deployment of future ballistic missile defense systems.

There is considerable overlap between BMD and ASAT technologies. Since even a poor ballistic missile defense system would probably have excellent ASAT capabilities, any ASAT limitation or test ban would almost certainly impede BMD development. Conversely, technology development ostensibly for advanced ASAT systems might provide some limited BMD capabilities, or, at minimum, information useful in BMD research.

Some available unilateral actions have clear benefits:

- Deployment of attack sensors on valuable satellites in order to provide information to support a retaliation decision;
- Deployment of a space-based, space surveillance system in order to provide information to support verification of compliance with future arms control agreements; to provide warning information required for effective evasion or dispensing of de coys; to support a decision to retaliate in the event of an attack; and to provide information required for the targeting of ASAT/DSAT weapons[4];
- Hardening of military satellites against nuclear effects to a modest degree in order to preclude "cheap kills" by nuclear-armed ICBMS, SLBMS, or ABMs;
- Development or maintenance of electronic countermeasures and electro-optical countermeasures, which would be relatively cheap, useful at all conflict levels, and unlikely to be prohibited by arms control agreements.

The ASAT weapon under development in the United States is sufficient to meet the threat posed by current, low-orbit Soviet military satellites.

Should the United States decide that it is in our national security interest to deploy ASAT weapons, the current MV program and, potentially, interceptors based on the recently tested HOE technology, are sufficient to respond to the threat posed by existing Soviet military satellites in low orbit. The current U.S. ASAT could be made even more effective by the addition of a spac~based space surveil-

[4]Because of its usefulness, such a surveillance system would bean attractive target for a Soviet ASAT attack. The ultimate utility of such a system, therefore, hinges on its survivability.

lance system to aid the process of targeting and/or additional basing facilities.

Many of the functions performed by Soviet military satellites may eventually be performed by more capable satellites orbiting at altitudes out of reach of the U.S. MV. Should this happen, it would provide a strong incentive to extend the MV'S capabilities by adding a larger booster or to develop a newer, more capable ASAT system.

COMPARISON OF POTENTIAL ASAT AND ARMS CONTROL REGIMES

There are widely varying views about the wisdom of deploying weapons which are to operate in space or against space objects. This fact, combined with more general concerns about the Soviet military threat and the dangers of the U.S./Soviet arms race, has made it difficult to forge a national consensus on the subject of ASAT weapons. Some people oppose A SAT weapons as a matter of principle because these weapons would operate in space or because such developments would contribute to the arms race. Others believe the benefits of ASAT weapons are outweighed by the risk they pose to current U.S. space systems, which are seen as essential for maintaining U.S./Soviet strategic stability. Still others see the development of A SAT and BMD weapons as a means to exploit U.S. technological advantages to enhance U.S. power, reduce the threat of conflict and global nuclear war, and reduce the damage done by such a war should it ever occur.

In its analysis, OTA has attempted to take into consideration this range of viewpoints and, to the greatest extent possible, show how it leads to a range of policy options. Many of the choices that will be made over the next several years will require a delicate balancing of strategic, economic, and political considerations. There is little doubt that reasonable persons can and will disagree as to the most appropriate nature of this balance.

Seven international legal regimes and corresponding military postures are considered critically below. Each of these regimes is intended to facilitate assessment of the effective ness and desirability of different combinations of A SAT and BMD technology development, satellite survivability, and arms control. Each regime is constructed so that it is different from the other regimes and so that it contains elements which might reasonably be expected to co-exist in the same proposal.

1. Existing Constraints

The first regime is defined by treaties and agreements presently in force; these are the Limited Test Ban Treaty, the Outer Space Treaty, and the Anti-Ballistic Missile Treaty. The existing international legal regime prohibits the use of A SAT capabilities except in self-defense, the testing or deployment of space-based weapons with BMD capability, and the testing or deployment in space of nuclear space mines or ASATS that would require a nuclear detonation as a power source.

Table 1-1 .—Effect of Regimes on ASAT Development and Arms Control

	Restrict with arms control	Develop ASAT weapons
Existing constraints	No	Yes
Comprehensive ASAT and space-based weapon ban	Yes	No
Test ban and space-based weapon ban . . .	Yes	Yes/No[a]
One **each/no new types** . .	**Yes**	**Yes**[b]
Rules of the road	**Yes**	**Yes**[c]
Space sanctuary	**Yes**	**Yes**[c]
Ballistic missile defense .	**No**	**Yes**

[a] In this regime ASAT weapons could be developed, tested, and deployed on Earth but not in space The United States could pursue ASAT development within the bounds of the treaty, or it could forego ASAT development entirely
[b] All ASAT weapons other than "current types" could not be tested or deployed in space
[c] Development and deployment optional but strongly supported by advocates of this regime

With these few exceptions, all other ASAT weapon development and deployment activities would be allowed. It is, therefore, permissible for the United States and the Soviet Union to develop and deploy coorbital interceptors (like the current Soviet system), direct-ascent interceptors (like the current U.S. system), terrestrial or space-based lasers, space-based neutral particle beam weapons, and weapons based on maneuvering spacecraft.

In the current regime both the United States and the Soviet Union could develop, test, deploy, and use such passive countermeasures as hiding, deception, evasion, hardening, and proliferation. Active, nondestructive defenses, such as electronic or electreoptical countermeasures, would also be allowed. Active, destructive defenses, such as shoot-back or DSATS, would be allowed as long as they did not violate any of the treaties enumerated above.

The primary advantage of the current regime is that it allows the almost unrestrained application of U.S. technology to the twin problems of protecting U.S. satellites and placing threatening Soviet satellites at risk. Under this regime, the United States would be free to use its comparative advantage in advanced technology to keep pace with expected developments in Soviet ASATS and other military satellites. Advanced U.S. ASATS might discourage the development of more capable Soviet space systems designed to place U.S. terrestrial assets at risk. In addition, the United States would be free to respond to Soviet A SAT weapons with increasingly sophisticated defensive weapons and countermeasures, thereby reducing the probability that the Soviets would ever use their intentional or inherent ASAT capabilities.

In the existing regime, research and development on new ballistic missile defense technologies can also proceed without the constraints that might be imposed by certain ASAT arms control regimes. Testing of advanced ASATS could provide valuable information that would contribute to the development of very capable BMD systems. Therefore, some types of generic space-weapon research could be conducted without first having to modify or withdraw from the ABM Treaty.

Some view advanced ASAT research as dangerous for this very reason. They argue that such research will gradually erode the usefulness of the ABM Treaty, thereby precipitating a defensive and offensive arms competition on Earth and in space. Rather than protecting satellites, a competition in space weapons might severely reduce their military utility. Under conditions of unrestrained competition, security might be purchased, if at all, only at the price of a substantial and sustained commitment to the development of increasingly sophisticated offensive and defensive space weapons. In such an environment, ensuring the survivability of satellites would require more than simple hardening or evasion. Costly measures might have to be taken such as the deployment of precision decoys, predeployed spares, or acquiring the ability to quickly reconstitute space assets. Satellites capable of defending themselves or a companion satellite might also have to be developed and deployed.

Should space-based weapons such as space mines or directed-energy weapons be deployed, these might be capable of the almost instantaneous destruction of a large number of critical satellites and ASATS. This could force nations into a situation in which they must "use or lose" their own pre-deployed space weapons. This might supply the incentive to escalate an otherwise manageable crisis.

2. Comprehensive ASAT and Space-Based Weapon Ban

A comprehensive ASAT and spacebased weapon ban would require the United States and the Soviet Union to agree to forgo the possession of specialized ASAT weapons, the testing—on Earth or in space—of specialized ASAT capabilities, the testing in an "ASAT mode' of systems (e.g., ICBMS or ABMs)

'Testing in an "A SAT mode" would include tests of ground-, air-, sea- or space-based systems against targets in space or against points in space.

which have inherent ASAT capabilities, and the deployment in space of any weapon. Such a regime would require the U.S.S.R. to destroy all of its coorbital interceptors and the United States to destroy all of its direct-ascent interceptors.[6]

Although this regime contains the most far--reaching arms control provisions, it would have the disadvantage of being the most difficult to verify. Unlike an ASAT test ban and space-based weapons ban regime, a comprehensive ban would prohibit possession and testing of A SAT weapons on Earth.7 Because the current Soviet coorbital interceptor is a relatively small spacecraft launched on a much larger, general-purpose booster, the Soviet Union could maintain and perhaps even expand its ASAT force without the the United States gaining unambiguous evidence of a violation.

Since the United States might agree to a comprehensive ASAT ban only after considerable domestic political friction over questions of compliance and verification, it is important to consider how such a ban might make a greater contribution to U.S. national security than a ban on ASAT testing and spacebased weapon deployment (discussed below). The purpose of both bans would be to prevent the use of ASATS, or, at minimum, to reduce the probability that an ASAT attack would be effective. An ASAT test ban would primarily affect weapons reliability, while an ASAT possession ban, if observed, would affect both availability and reliability. It is conceivable that the risk posed by possible illegal Soviet use of ASAT weapons might be somewhat lower in a regime in which the Soviets could not lawfully possess ASAT weapons. Presumably, the inability to overtly possess ASAT weapons would diminish one's ability to use them effectively. Furthermore, an absolute ban on possession might make it less likely that the current generation of ASAT weapons could be upgraded and held in readiness in significant numbers.

However, if the United States can only be confident that the Soviets are complying with a treaty to the extent we can verify compliance, then the United States would not have confidence that this regime offered any greater protection to our satellites than would a test ban and space deployment ban.

3. ASAT Weapon Test Ban and Space-Based Weapon Deployment Ban

In this regime, in addition to adhering to treaties and agreements presently in force, the Soviet Union and the United States would agree to forgo all testing in an "A SAT mode" and the deployment of any weapon in space. Such a ban would not only prohibit the testing of both current and future ASAT systems but would also place similar restrictions on BMD systems with ASAT capabilities. This regime would not ban terrestrial research on ASAT or space-based weapons and would not attempt to ban their possession. Therefore, if it were judged to be desirable, ASAT and BMD weapons could be developed (though not tested in space) and held in readiness on Earth.

In a test ban regime, the passive countermeasures and nondestructive active countermeasures that were discussed in the "existing regime" could still be developed and employed. Destructive active countermeasures such as "shoot-back" or DSATS could not be tested or deployed but could be developed and held in readiness.

Although a ban on testing in an "ASAT mode" would not eliminate all threats to satellites, it would reduce the cost and complexity of ensuring a reasonable level of satellite survivability. The United States would still benefit from 'hardening' its satellites and deploying spares and decoys, but the more elaborate, expensive, precaution of developing and deploying DSATS would be prohibited and, indeed, less attractive. In the absence of reliable, effective ASATS, satellites would pre

[6]Such an agreement might resemble the draft treaty proposed to the United Nations by athe U.S.S.R. in August of 1983, except that draft also bans the testing or use of manned spacecraft for military purposes. See U.N. Document A/38/194, Aug. 23, 1983.

[7]A comprehensive ban would not ban systems with inherent ASAT capabilities, such as ICBMs, ABMs, and maneuverable spacecraft,

Table I-2.—Sensor Technology for Compliance Monitoring

Prohibitable action	Observable	sensors
ASAT attack:		Attack sensors:
KEW[a] impact	acceleration	accelerometers
Pulsed HEL[b] irradiation . . .	acceleration	accelerometers
Continuous HEL irradiation	heating	thermistors
NPB[c] irradiation	ionization	ionization detectors
Keep-out zone penetration . . .	position of thermal radiation source (ASAT)	space-based LWIR[d] thermal image~ [f]
Interception test	positions of thermal radiation sources (ASAT and target)	space-based LWIR thermal imageP [f]
NPB ASAT operation	thermal radiation from ASAT	space-based LWIR thermal imager[e]
HEL ASAT operation	thermal radiation from ASAT	space-based LWIR thermal image~ [f]
Irradiation of target with NPB	gamma radiation from target	gamma-ray spectrometer
Irradiation of target with pulsed HEL	thermal radiation from target	space-based LWIR thermal imager
Irradiation of target with pulsed HEL	reflected radiation from target	space-based multi spectral imager
Irradiation of target with continuous HEL	position of thermal radiation source (target)	space-based LWIR thermal imager
Irradiation of target with continuous HEL	reflected radiation from target	space-based multi spectral imager
Nuclear explosive aboard satellite	gamma radiation from fissile or fusile nuclei activated by cosmic radiation or by particle _beams	gamma-ray spectrometer (and optional particle beam generator)

a/(ir-r@IC.0n0r9Y weapon

[b]Htgh.energy laser

[c]Neutral. Darticle beam

dl-~ l th Infrared

eTh LWIR telescope on the Infrared Astronomical Satellite (IRAS) exemplifies demonstrated space-based thermal imager technology, this Instrument IS described in *Astrophysical Journal, 278* (1, Pt. *2)*, L1 -L85, Mar 1, 1984 (Special Issue on the Infrared Ast ronomical Satellite)

fRadar and Passive radio direction.finding methods could also be useful for tracking, if hiding measures are not employed by the penetrating spacecraft LWIR tracking is emphasized here because it is difficult to counter by such measures

gA target irradiated by a high-energy neutral particle beam will emit gamma rays, neutrons, and other observable particles, just as it Will, at a slower rate, when bombarded by natural cosmic rays These gamma rays could be detected by a gamma-ray spectrometer such as those which have been carried by Soviet Venusian and lunar landers and by U S NASA Ranger and Apollo spacecraft (NASA report SP-387, pp 3 20)

sumably be of greater utility since the United States might have higher confidence that they would be available when needed.

Relative to the existing regime, the primary advantage of a regime banning testing of ASAT capabilities and deployment of space-based weapons would be that highly valued U.S. satellites in higher orbits—e.g., the future MILSTAR system–could be protected with some confidence from advanced A SAT weapons, especially if protected as well by passive countermeasures. The fact that advanced ASATS could not be overtly tested would reduce the probability that they would be developed and deployed. If they were developed and used without prior testing, a test ban would reduce the probability that they would be successful.

As in the existing regime, the United States could retain a capability to attempt to negate low-altitude Soviet satellites with its MV ASAT (or, possibly, with interceptors based on the HOE technology) since a "no test" ban would not prohibit ASAT possession. However, confidence in the operational capability of both the U.S. and Soviet ASAT systems would degrade over time without continued operational testing.

There would be two important disadvantages to this regime. First a ban on testing in an "A SAT mode" and deploying space-based weapons would not offer absolute protection for satellites; there would remain some possibility that an untested–or covertly tested—advanced ASAT, if suddenly deployed and used, might actually work well enough to overcome passive countermeasures. Second, without an ASAT weapon the United States would lack a fully tested means to attack threatening satellites. The United States would, therefore, have to place greater reliance on countermeasures to protect its terrestrial assets. It is unclear whether countermeasures alone will be able to keep pace with the threat posed by advances in military satellites.

Depending on one's viewpoint, an additional advantage or disadvantage of this regime is that the testing of some types of advanced BMD weapons would be prohibited. This prohibition might even include some ground-based BMD weapons such as the U.S. HOE (Homing Overlay Experiment) ABM interceptor, which is currently allowed under the ABM Treaty. Although such limitations would only be slightly more restrictive than those of the ABM Treaty, they would be very restrictive when compared to a regime in which the ABM Treaty was no longer in force.

4. One Each/No New Types

Regime four would include arms limitation provisions which would restrict the United States and the Soviet Union to their current ASATS and prohibit the testing in an "A SAT mode' and deployment, in space, of more advanced systems. Existing treaties and agreements would remain in force. In addition to banning the testing or deployment in space of new types of ASATS, the "no new types" agreement would prohibit making current systems more capable so they could attack targets at higher altitudes. BMD systems would also be banned if they had ASAT capabilities.

In a "no new types" regime, the passive countermeasures and nondestructive active countermeasures that were discussed in the "existing regime" could still be developed and employed. Destructive active countermeasures such as "shoot-back" or DSATS could not be tested or deployed but could be developed and held in readiness. Current ASATs—should they already possess the capability when the treaty is signed-could be used to attack other ASATS.

The primary advantage of a "no new types" regime, relative to the existing regime, would be that, by prohibiting the testing of advanced A SAT weapons, highly valued U.S. satellites in higher orbits could be protected with some confidence. In addition, the United States could retain a capability to negate low-altitude Soviet satellites (e.g., RORSAT) in the event of war and to respond in kind to a Soviet ASAT attack.

A primary disadvantage of a "no new types" regime would be that allowed (i.e., tested, nonnuclear) U.S. ASAT weapons would be inadequate to negate threatening Soviet satellites if such satellites were moved to higher orbits–a feasible but technologically difficult and costly Soviet countermeasure. An additional disadvantage to this regime is that attempts to define "new types" of ASATS would be likely to result in the same ambiguity and distrust that resulted from attempts to define "new types" of ICBMS in the SALT II negotiations. Finally, the degree of protection afforded high-altitude satellites by a ban on testing "new types" would be uncertain; there would remain some probability that an untested advanced ASAT, if suddenly deployed and used, might actually work. Systems with inherent ASAT capabilities (ICBMS, ABMs, maneuvering spacecraft) would also still exist.

As in the test ban and space-based weapon ban regime, a "no new types' regime would limit the testing of some types of advanced BMD weapons which are currently allowed under the ABM Treaty.

5. "Rules of the Road" for Space

Whether or not the United States and the Soviet Union agree to restrict ASAT weapons, they might negotiate a set of "rules of the road" for space operations. These rules could serve the general purpose of reducing suspicion and encouraging the orderly use of space, or they could be designed specifically to aid in the defense of space assets. Examples of general rules might include agreed limits on minimum separation distance between satellites or restrictions on very low-altitude overflight by manned or unmanned spacecraft. These general rules might also be used to establish new, stringent requirements for advance notice of launch activities. Specific rules for space defense might include agreed and possibly defended "keep-out zones, " grants or restrictions on the rights of inspection, and limitations on high-velocity fly-bys or trailing of foreign satellites. It might also be desirable to establish a means by which to obtain timely information and consult concerning ambiguous or threatening activities.

The "rules of the road" discussed above—if implemented in the absence of restrictions on ASAT weapon development—would not remove the threat of ASAT attack. The primary purpose of such a regime would not be to restrict substantially the activities of the parties, but rather, to make the intentions behind these activities more transparent. Although the degree of protection for U.S. space assets to be gained from a "rules of the road" agreement would be less than from other arms limitation regimes, the costs would also be correspondingly less if other nations failed to comply with such rules. One must assume that in the absence of ASAT arms control, both ASAT development and satellite survivability programs will be given high priority. This being the case, offensive and defensive measures would be available to respond to violations of "rules of the road. "

If they were defended, "keep-out zones" would probably offer the closest thing to security in a "rules of the road" regime. Space mines designed to shadow satellites and detonate on command would lose a great deal of their utility if held at bay by a defended keep-out zone. Nonetheless, there are a number of difficulties with trying to implement this regime, not the least of which would be the reaction of other space-faring nations.

ASAT weapons such as nuclear interceptors must be kept at a range of several hundred kilometers from moderately hardened satellites in order to protect such satellites; advanced directed-energy ASAT weapons might have to be kept much farther away. Given the number of satellites currently in orbit, this would present several problems. Satellites in geostationary orbit are already so closely spaced that a keep-out zone sufficiently large to protect satellites from a nuclear weapon would displace other satellites. It is possible that critical strategic warning and communications satellites could function in supersynchronous orbits.[8] If so, there would be adequate room to accommodate large keep-out zones around satellites in such orbits.

[8]I.e. higher than geosynchronous orbital altitude.

There are too many satellites in low-Earth orbit to accommodate large keep-out zones. However, it might be feasible to establish smaller keep-out zones around such satellites and, in addition, to specify a minimum angular separation between orbital planes to prevent continuous trailing.

6. Space Sanctuary

Regime six would establish altitude limits above which military satellites could operate but where the testing or deployment of weapons would be forbidden. A "space sanctuary" regime would not constrain ASAT weapon development, testing, or deployment in space but would attempt to enhance security by prohibiting these activities in deep space (i.e., above 3,000 nautical miles, or about 5,600 kilometers) where critical strategic satellites are based. At present, the altitude of these strategic satellites makes them invulnerable to attack by the current Soviet and U.S. ASATS.

In a "space sanctuary" regime, the passive countermeasures and nondestructive active countermeasures that were discussed in the "existing regime" could still be developed and employed. Unlike the "test ban" or "no new types" regime, destructive, active countermeasures such as DSATS could be tested and deployed, but not in deep space. Deployment in deep space of "shoot-back' capabilities or DSATS would probably be prohibited since it might be impossible to differentiate these weapons from offensive ASATS.

The primary advantage of this regime would be that it could protect satellites in high orbits from the current generation of ASAT weapons. In addition, a deep-space sanctuary regime would constrain ASAT development less than would a comprehensive test ban regime or a no-new-types regime. However, should the United States and the Soviet Union choose to pursue advanced ASAT weapons, a space sanctuary might offer only limited protection.

The greatest risks in a space sanctuary regime would be posed by advanced directed-energy weapons which could be tested and de-

ployed at low altitudes. Such testing and deployment would probably be adequate to guarantee effectiveness against targets at higher altitudes. Satellites at very high, supersynchronous altitudes might still derive some protection from this regime, but violation of the sanctuary by highly maneuverable kinetic-energy weapons or by satellites covertly carrying powerful nuclear or directed-energy weapons would remain a risk. For this reason, sanctuaries might provide less security than would keep-out zones (discussed above), because any foreign satellite entering an agreed keep-out zone could be fired upon, while a satellite entering a sanctuary could be lawfully fired upon only if it could be proven that it was, or carried, a weapon.

7. Space-Based BMD

The seventh regime might result from U.S. or Soviet withdrawal fro-m the ABM Treaty followed by the deployment of space-based BMD systems. Since even a modest BMD system would make a very capable A SAT weapon, in a "space-based BMD" regime there could be no attempt to restrain ASAT development. Moreover, each side would probably want the freedom to develop new A SAT weapons capable of destroying the opponent's space-based BMD systems.

The ASAT weapons allowable under the "spacebased BMD" regime would include all of those in the "existing regime, plus weap-

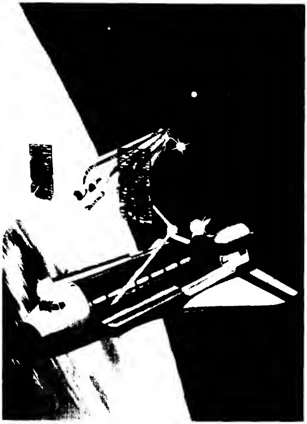

Photo credit U S Department of Energy Los Alamos National Laboratory

Artist's conception of the Space Shuttle deploying a neutral particle beam weapon.

Photo credit U S Department of Defense

Artist's conception of a manned Soviet space plane attacking a satellite

Neither of the weapons illustrated here exists today, but in the absence of agreed limitations, both the United States and the Soviet Union will probably develop a wide range of advanced space weapons.

ons capable of countering ballistic missiles in flight. Defensive measures would be less constrained and more essential than in the "existing regime. In particular, advanced spacebased weapons such as neutral particle beam weapons could be deployed at low altitudes and then used as ASAT or DSAT weapons. Passive countermeasures and nondestructive active countermeasures like those discussed in the "existing regime" would be developed and employed.

Depending on one's viewpoint, the principal advantage, or disadvantage, of a space-based BMD regime would be that it would allow the United States and the Soviet Union to deploy highly capable weapons in space. On March 23, 1983, President Reagan called for a vigorous research program to determine the feasibility of advanced BMD systems, suggesting that the deployment of such systems, if feasible, could offer an alternative to the current stalemate in strategic nuclear weapons. Given the inherent ASAT capabilities of advanced BMD weapons, satellites would be most vulnerable in a space-based BMD regime. Before the United States deployed space-based BMD systems it would have to determine, first, that the contribution that such systems made to U.S. security was great enough to compensate for the threat which similar opposing systems would pose to U.S. satellites; and, second, that space-based BMD components could be protected at competitive cost against advanced ASAT weapons.

ASAT countermeasures must prove to be effective for spacebased BMD platforms if a decision to deploy them is to make sense. Perhaps large improvements in the effectiveness or economy of passive countermeasures such as combinations of hardening, deception, and proliferation would provide the needed protection. Alternatively, the superior fire-power or massive shielding of BMD weapons might give them a degree of protection unattainable by smaller, less capable satellites.

With respect to other military satellites, the expense of equipping them with countermeasures to insure some level of survivability against advanced BMD systems would be considerable. However if, as some argue, spacebased missile defenses could make us more secure and encourage the Soviets to make real reductions in offensive missiles, this would reduce the threat of U.S./Soviet conflict. In a world where conflict was less likely, satellite vulnerability would be less important.

Others, of course, disagree strongly with this argument. They claim that space-based missile defenses will decrease our security by encouraging greater competition in both offensive and defensive weapons. In a world of space-based weapons and higher U.S./Soviet tension, satellite vulnerability would be a critical and potentially destabilizing factor.

TREATIES OF LIMITED DURATION

Each of the regimes examined above could be negotiated as a treaty of indefinite or limited duration or, alternatively, as one which remained in force as long as periodic reviews were favorable. Each of these alternatives would have its advantages and disadvantages. Treaties of indefinite duration are more effective at discouraging the pursuit of banned activities, yet require a greater degree of foresight regarding the long-term interests of the signatories and can foreclose technological options for the indefinite future.[9] Treaties of limited duration allow parties to take advantage of future technological options, yet can

Wheaties of unlimited duration usually contain a clause which states that if a country's "supreme national interests" are threatened, then that country may withdraw from the treaty, In addition to "supreme national interest clauses, " treaties may also contain specific unilateral or agreed statements regarding specific understandings about related events. For example, The 1972 ABM Treaty contains a unilateral statement by the LJnited States which links the continued viability of the treaty to "more complete limitations on strategic arms. "

encourage aggressive development programs designed to reach fruition at the termination of the designated period. Treaties which call for a periodic reassessment of agreed limitations in theory have great flexibility, yet, in practice, often result in a strong presumption that they should be continued.

The United States might, for example, enter into a treaty limiting ASATS with the explicit and public reservation that we would withdraw from this treaty if and when we were ready to test and deploy a ballistic missile defense system in ways that the ASAT Treaty would forbid. Alternatively, we might take the public position that we intended to restrict our BMD activities so as to remain within the limits of an ASAT Treaty. While the former position would suggest a treaty of limited duration and the latter a treaty of unlimited duration, this need not be the case. It would be perfectly possible to sign a treaty of unlimited duration, with the standard provision allowing for withdrawal, accompanied by a clear statement of some of the conditions under which we intended to withdraw.

From one point of view, the exact language in a treaty regarding its duration would be less important than the intentions of the parties. After all, there have been numerous examples of treaties of unlimited duration that were violated soon after they were signed and examples of treaties of limited duration that continued in force after they had expired (e.g., the "Interim Offensive Agreement" signed at SALT I). The real issue would be whether the parties believe that adherence to the treaty in question continued to be in their national security interest.

The Reagan Administration has recently indicated that it intends to conduct ASAT tests to gather information useful in advanced BMD research.[10] Given the close connection between these two technologies, an ASAT treaty of even limited duration would require modification of current SD I program plans. Thus, to the extent that the United States wished to maintain the most rapid pace of advanced BMD research within the bounds of the ABM Treaty, such a treaty would not be desirable. Conversely, to the extent that the United States wished to slow the pace of Soviet BMD research and would be willing to de fer decisions regarding the testing of space-based or space-directed weapons, an ASAT treaty of limited duration could contribute to that result.

[10] The purpose of tests ' 'in an ASAT mode' would be to investigate advanced technologies without violating the ABM Treaty. The Department of Defense recently told Congress that, "To ensure compliance with the ABM Treaty the performance of the demonstration hardware will be limited to the satellite defense mission. Intercepts of certain orbital targets simulating anti-satellite weapons can clearly be compatible with this criteria. " [Report to the Congress on the *Strategic Defense Initiative*, Department of Defense, 1985, app. B, p. 8.]